THE CLAIMS

What is claimed is:

1. A solution for use in connection with the deposition of one or more metals on electroplatable substrates, which comprises:

water;

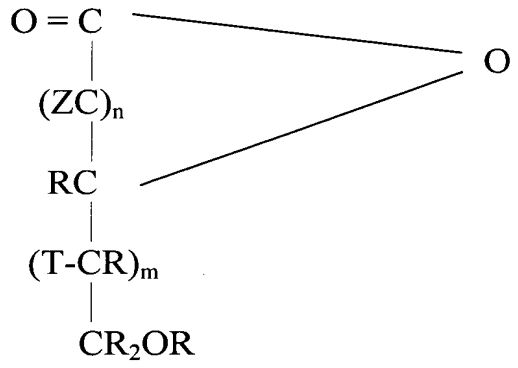
a metal ion in an amount sufficient to provide a metal deposit on a platable substrate;

a complexing agent of an organic compound having between 4 and 18 carbon atoms which compound includes at least two hydroxyl groups and a five or six membered ring that contains at least one oxygen atom, with the compound being present in an amount sufficient to complex the metal to render it soluble in the solution and to inhibit oxidation of the metal; and

a pH of the solution in the range of between 3.5 and 5.5, adjusted, if necessary, by the addition of a suitable pH adjusting agent;

wherein the complexing agent and metal ion are present in a concentration ratio of between about 2:1and 9:1 to reduce or minimize agglomeration of the substrates during electroplating.

2. The solution of claim 1 wherein the complexing agent has the structure:



wherein each R is the same or different and is hydrogen or a lower alkyl group of 1 to 3 carbon atoms, T is R, OR, or $O=P(OR)_2$-, Z is O= or RO-, n is 2-4 and Z can be the same or different in each occurrence in the compound, and m is 1-3, or the complexing agent is a soluble salt of such structure.

3. The solution of claim 2 wherein the complexing agent is ascorbic acid, isoascorbic acid, dehydroascorbic acid, glucoascorbic acid, galacturonic acid, glucoronic acid, or a salt thereof, or is derived from a ketogluconate or heptagluconate and is present in an amount of about 25 to 200 g/l.

4. The solution of claim 1 wherein the metal is tin and is added to the solution as a stannous alkyl sulfonate salt, a stannous sulfate salt, a stannous chloride salt, a stannous ascorbate salt, or stannous oxide and is present in an amount of between about 5 and 100 g/l.

5. The solution of claim 4 further comprising a divalent lead salt in an amount sufficient to deposit a tin-lead alloy from the solution.

6. The solution of claim 1 which further comprises a conductivity salt in an amount sufficient to increase the conductivity of the solution.

7. The solution of claim 6, wherein the conductivity salt is an alkali or alkaline metal sulfate, sulfonate, or acetate compound.

8. The solution of claim 1 further comprising a surfactant in an amount sufficient to enhance deposit quality and grain structure.

9. The solution of claim 8 wherein the surfactant is an alkylene oxide condensation compound and is present in an amount of about 0.01 to 20 g/l.

10. The solution of claim 1 further comprising an agent to promote anode dissolution.

11. The solution of claim 10 wherein the agent to promote anode dissolution is as potassium methane sulfonate, ammonium chloride or a metal sulfide salt.

12. The solution of claim 1, wherein the substrates are composite articles having electroplatable and non-electroplatable portions, the pH adjusting agent is an acid or a base and the pH is adjusted to the range of about 3.5 to 5.5 to enable electroplating of the electroplatable portions of the articles without deleteriously affecting the non-electroplatable portions.

13. A solution for use in connection with the deposition of tin or tin-lead alloys on electroplatable substrates, which comprises:

water;

a stannous ascorbate compound;

a complexing agent of an organic compound having between 4 and 18 carbon atoms which compound includes at least two hydroxyl groups and a five or six membered ring that contains at least one oxygen atom, with the compound being present in an amount sufficient to complex tin ions to render them soluble in the solution and to inhibit oxidation of the tin ions;

when desired, a divalent lead compound in an amount sufficient to deposit a tin-lead alloy from the solution; and

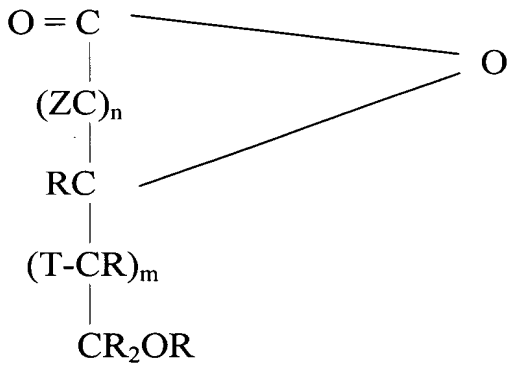
a pH of the solution in the range of between 3.5 and 5.5, adjusted, if necessary, by the addition of a suitable pH adjusting agent;

wherein the complexing agent and metal ion are present in a concentration ratio of between about 2:1and 9:1 to reduce or minimize agglomeration of the substrates during electroplating.

14. The solution of claim 13, wherein the substrates are composite articles having electroplatable and non-electroplatable portions, the pH adjusting agent is an acid or a base and the pH is adjusted to the range of about 3.5 to 5.5 to enable electroplating of the electroplatable portions of the articles without deleteriously affecting the non-electroplatable portions.

15. The solution of claim 13, further comprises at least one of a conductivity salt in an amount sufficient to increase the conductivity of the solution or a surfactant in an amount sufficient to enhance deposit quality and grain structure.

16. The solution of claim 13, wherein the stannous ion is present in an amount of between about 5 and 100 g/l and the complexing agent is present in an amount of about 25 to 200 g/l and has the structure:



wherein each R is the same or different and is hydrogen or a lower alkyl group of 1 to 3 carbon atoms, T is R, OR, or $O=P(OR)_2$-, Z is O= or RO-, n is 2-4 and Z can be the same or different in each occurrence in the structure, and m is 1-3, or the complexing agent is a soluble salt of such structure.

17. The solution of claim 16 wherein the complexing agent is ascorbic acid, isoascorbic acid, dehydoascorbic acid, glucoascorbic acid, galacturonic acid, glucoronic acid, glucose-6-phosphate, or a salt thereof, or is derived from a ketogluconate or heptagluconate and is present in an amount of about 25 to 200 g/l.

18. The solution of claim 17, wherein the conductivity salt is an alkali or alkaline metal sulfate, sulfonate, or acetate compound and the surfactant is an alkylene oxide condensation compound and is present in an amount of about 0.01 to 20 g/l.

19. A method for electroplating a metal deposit on a substrate which comprises contacting a plurality of such substrates with the solution of claim 1 and passing a current though the solution to provide metal electrodeposits on the substrate without causing significant agglomeration of such substrates during electroplating.

20. A method for electroplating a tin or tin-lead deposit on a composite article that includes electroplatable and non-electroplatable portions which comprises contacting a plurality of such articles with the solution of claim 13 and passing a current though the solution to provide tin or tin-lead electrodeposits on the electroplatable portions of the articles without deleteriously affecting the non-electroplatable portions of the articles.